

# **Formation of submicrocrystalline structure in large size billets and sheets out of titanium alloys**

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Production of semi-finished products with a submicrocrystalline (SMC) structure can be rather beneficial for manufacturing articles due to considerable improvement of their mechanical properties. Recent achievements in processing of large size billets and sheets with SMC structure out of a commercially pure (CP) titanium and a Ti-6Al4V titanium alloy using severe plastic deformation (SPD) process by “abc” forging will be reported and discussed.

The microstructure evolution and mechanical behavior of titanium and Ti-6Al-4V alloy during successive compression test in three orthogonal directions (at 400 and 550°C respectively) were studied and conditions for formation of the SMC structure were determined. The key role of strain localization in macroscopic scale bands for refining microstructure was shown. Structure changes within macrobands, their evolution and relationship with the SPD process were investigated. Macroscopic and microscopic scales of deformation are connected via mesoscopic scale processes. In titanium the microstructure evolution occurs via self-organization of dislocations in deformation-induced high angle boundaries, the interaction of which at their intersections, resulted from a change in the strain direction, leads to formation of submicron grained structure and strengthening. In the two-phase alloy there takes place formation of shear bands, dividing plates of phases into fragments, which afterwards are spheroidized due to formation of high angle grain boundaries and transformation of semicoherent interphase boundaries to noncoherent ones. In this case the mesoscopic scale deformation is determined by cooperative grain boundary sliding leading to superplastic flow and softening.

The results of the microstructure evaluation after SPD and processing of large-scale billets and sheets with a homogeneous SMC structure in titanium and its alloys are considered. Billets with dimensions 200 mm in length and 150 mm in diameter and sheets with dimensions 1500×500×2 mm<sup>3</sup> were produced. Their mechanical properties were studied and advantages of SMC semi-finished products are discussed.